

4. On *Palæolampas*, a new Genus of the Echinoidea. By F. JEFFREY BELL, B.A., F.R.M.S., F.Z.S., Professor of Comparative Anatomy in King's College, London.

[Received January 27, 1880.]

(Plate IV.)

There is, perhaps, no experience which is more full of instruction to the zoologist than the discovery of forms as recent that have been previously regarded as extinct. In no group of the animal kingdom have the explorations of the last few years reaped so large a harvest as among the Echinoidea, as *Salenia* and *Conoclypeus*¹ would suffice to bear witness, were not such forms as *Phormosoma* and *Asthenosoma* still more remarkable. But there is yet another possibility—possible, indeed, in the case of terrestrial animals, but infinitely more probable in the case of deep-sea forms; it is this: we may at times be fortunate enough to find examples of genera which, though hitherto not registered as fossil, yet proclaim by their general aspect, structure, and relations their archaic characters and the great length of time during which they must have existed as distinct forms. Prime among such creatures stands the remarkable *Brisinga*, which, though “the most primitive and therefore the oldest of all Echinoderms,”² has not yet been known to naturalists for a quarter of a century³.

Very far from being either as important or as interesting as this ancient Starfish, the irregular Echinid which I now propose to describe to the Society is of interest as filling a gap in our series of forms. Nearly every naturalist who has seen it has at first thought that he had seen it before; but further investigation has, in all cases, led to the view that the form is different from any yet observed. To this statement there is but one exception: Dr. R. H. Traquair, F.R.S.E., of the Museum of Science and Art in Edinburgh, informed me some months ago that he had a specimen generically, if not specifically identical, which had come into his hands when the collection of the late Dr. S. P. Woodward was dispersed. Dr. Traquair most kindly and generously offered to send me notes and drawings of this specimen; but the arduous duties of his post at Edinburgh have been hitherto an obstacle in his way; and while I regret that I have to describe the specimen in the collection of the British Museum without giving an account of the Edinburgh example, I have felt too much sympathy with my friend and colleague to have pressed him too hardly to add to his labours. Some day, perhaps, in the future Dr. Traquair will himself give an account of the form under his care.

The specimen now to be described came into the possession of the Trustees of the British Museum so long ago as January 1852; but it

¹ A. Agassiz, Bull. M. C. Z. v. no. 9, p. 190.

² G. O. Sars, ‘Researches on the Structure and Affinity of the genus *Brisinga*’ (1875), p. 94.

³ ‘Fauna littoralis Norvegiæ,’ ii. (1856) p. 95.

was not mentioned or described by the late Dr. Gray in his 'Catalogue of the Recent Echinida,' published in 1855. It is much worn and has much the appearance of a fossil specimen; in the opinions of Prof. Morris and of Dr. Henry Woodward, F.R.S., however, the specimen is recent. It was bought at Stevens's sale-rooms, and is, with a doubt, reported to have come from India. To the accomplished palæontologist just named I have to express my thanks for instructed guidance through the cabinets under his charge; and while I take on myself all responsibility in describing this form, I would say at once that it is the fact that it was unknown to Dr. Woodward which has chiefly led me to regard it as new.

As we pass in review the edentulous forms of the Irregular Echinoidea, we are led irresistibly to the conclusion that the shortening of the ambulacra and the arrangement of the pores in the mode which has led Prof. Hückel to give to the group the name of *Petalosticha*¹, are structural changes which have gone hand in hand; and, just as we may say of the ungulate Mammalia that their limbs tend to become modified by the reduction of the outer digits, and that, where success is attained, this reduction is accompanied by concomitant changes in the relations of the metacarpal or metatarsal bones to the carpus or tarsus², or of the Araneina that they have tended to limit their stigmata to two³, so may we say of the *Petalosticha* that the arrangement of the ambulacral pores in straight parallel rows is more ancient than that in which the greater number are set in petaloid fashion. So far the generalization is borne out by the evidence of the palæontological succession, while some of the observations of Alex. Agassiz seem to support it on the embryological side. Perhaps we may go a step further and say, with safety, that the longer, the more regular, and the straighter are, step for step, older arrangements than rows of pores less long, less regular, or less straight. It is obvious that all kinds of stages may be found in this series if the regular and orderly modification of the Echinoderm structure has taken place in the non-saltatory fashion which it is now the mode to ascribe to the process of Evolution; but there is another possible process which it is, after all, not so much more difficult to present distinctly to the imagination; and that is progression by leaps of varying breadth⁴. Prof. Agassiz has drawn attention to the sudden transitions which he has observed in the growth of an individual, and to the apparently sudden appearance of genera in their geological succession. Let us test these two conflicting views by the evidence afforded by the new genus; but before doing so, let us point out that, even if we shall find evidence in favour of the sudden or, as we may call it, saltatory character of the transitions, it is just what we seem to find also in the developmental history of the individual; so that it affords us, just as well as any more steady succession, quite as complete a demonstration of the

¹ Gener. Morphologie, ii. p. lxxiv.

² Kowalevsky, Proc. Roy. Soc. 1873, p. 153.

³ Cf. Bertkau, Archiv für Naturg. 1878, pp. 351 *et seq.*

⁴ In the sense, of course, that the intermediate forms were so rapidly passed over that the chance of their being preserved is practically *nil*.

aphorism "The development of the individual is a compressed epitome of the development of the race;" and we may further look for an explanation of the suddenness of the changes in the supposition that between definite points in organization neither the larval form nor the adult are enabled to maintain that equilibrium in the presence of external forces which is necessary to the maintenance of existence¹. Whether this be so or not, neither the doctrine of Descent nor the "fundamental principle of biogenetic development" has its truth in any way affected thereby.

It is with considerations of this kind in our mind that we must, as I think, address ourselves to the consideration of intermediate forms; for, in our times at least, it is only when observation is kindled by the light of the doctrine of the Descent that the full value of "inosculant forms" can be justly estimated.

Description of the Specimen.

Ambulacral system.—The paired arrangement of the ambulacral pores does not extend beyond the ambitus, which is very nearly reached by all the five sets, but most completely by the two postero-lateral; the two rows of each are, in the case of the postero-lateral and of the anterior ambulacrum, altogether equal; but in the antero-lateral ambulacra the anterior row of pairs of pores is a little shorter than the posterior, and this difference is best marked on the left side; the strictest parallelism is observed between the paired rows, which incline so slightly towards one another that the diminution in breadth of the intraambulacral space cannot be detected by the eye until the pores come close to the central or apical system; here the pores diminish considerably in size, but there is no bare space separating the perforated ambulacral plates from the azygos radial plate, ordinarily known as the ocular. The pores of the inner row in each pair are still fairly circular; those of the outer are more slit-like or comma-shaped; and it is evident, so soon as several different pores have been examined, that the specimen in question exhibits a commencement of that union of the two pores by means of a connecting furrow which is very much more, and quite distinctly, marked in *Echinolampas*, and is even to be seen in *Conoclypeus leskii*, Goldfuss². The spacing-out of the ambulacral pores as they approach the point at which the paired arrangement ceases to obtain is here but barely marked; and, indeed, it would be impossible to detect it at all, were we not led to look for it from the marked degree which it reaches in *Echinolampas*; so, again, while it is in some cases possible to see that the terminal pores of the outer row of the ambulacra are as completely circular as those of the inner row, and so far to find an analogy with the much more marked similarity in *Echinolampas*, yet in the cases of other rows on the same

¹ The probability of sports leading to very considerable and remarkable changes in organization has, comparatively lately, received support from the observations of Mr. Bullar on the hermaphroditism of certain parasitic Isopoda (Journ. Anat. & Phys. vol. xi. pp. 118-124).

² 'Petrefacta Germaniæ,' tab. xlii. figs. 1, a-c.

specimen the difference between the outer and inner pore can still be observed, just as well as in the upper portion of the rows. What, however, is more remarkable now remains to be noted: the outer row of pores may be traced from the point where they cease to be accompanied by the inner row as far as the actinal region, and that with complete regularity of spacing, and in lines which only here and there diverge from being completely straight; when they reach the phyllode they of course exhibit some modification; but that is of no importance for the moment. What we have here is the regular repartition of one row of pores from the apical to the oral pole. In this, as in several other points, the specimen under description approaches the genus *Conoclypeus*, the existence of which in the present epoch has been lately signalized by Prof. Alex. Agassiz¹: in *Conoclypeus sigsbei* the paired arrangement of the ambulacral pores does not extend over more than two thirds of the abactinal surface, while *C. anachoreta*, Agassiz (L.), is seen to retain the paired arrangement from the apical to the oral area (see Desor, *Échinides fossiles*, pl. xxxiii. figs. 5-7).

We may find, then: the following series:—

Conoclypeus anachoreta: pores in pairs extend over the whole of the ambulacral area.

Palæolampas, nov. gen.: pores in pairs extend to the ambitus; outer row extend to the peristome regularly.

Conoclypeus sigsbei: pores in pairs extend over part only of the abactinal area; outer rows as in *Palæolampas*.

Echinolampas: pores of corresponding paired rows unequal.

E. depressa: pores of outer rows extend regularly to actinostome.

E. oviformis: pores of outer row not regularly distributed on the plates between ambitus and actinostome.

Neolampas: pores in single row (paired arrangement altogether lost).

Whether the mass of their characters is not such as to justify the union of *C. anachoreta* and *C. sigsbei* in a single genus, and the generic separation of the new form (*Palæolampas*), is a point which I will discuss later on. The table as here arranged, seems to throw discredit on the union of *Echinolampas depressa* and *E. oviformis* in the same genus; but there are other points of importance in the structure of the Echinoderm than the characters of the ambulacral system, and these must have their due weight.

The bourrelets of the actinal system are distinct, but they do not project into the buccal cavity; they are well rounded, not pointed at all, and may be said to be due rather to the development of the phyllodes, which mark off the interambulacral periphery of the actinostome, than to any modification in the interambulacral plates themselves; judging from the photograph of *C. sigsbei*, they are less developed than in that new form, while they have no such sharp projection as in *Echinolampas oviformis*; the outer row of pores bends slightly outwards, and then inwards so as to approach its fellow;

¹ Bull. Mus. Comp. Zoology, v. no. 9, p. 190.

between these there are a few pores not very regularly or definitely arranged, but apparently not so extensive as in *C. sigsbei*.

The ocular plates are very distinct; but two of the pores, the anterior median (which is almost obliterated), and the left postero-lateral, are smaller than the rest; those of the right side are both interesting as exhibiting indications of their primitively double character—a point to which Prof. Lovén has called attention in his invaluable 'Études'¹, and which, as is well known, is so distinctly marked in *Palæechinus* among older forms².

Interambulacral system.—The interambulacral areas are composed of large broad plates and are considerably wider than the ambulacral, but there are no points of especial importance to be noted with regard to them; the odd posterior genital plate has disappeared, and the madreporic plate occupies the whole of the central portion of the apical area. The two postero-lateral pores are a very little more widely separated from one another than are the more anterior pair; but the divergence is not in any way so marked as it is either in *Echinolampas* or in *Conoclypeus sigsbei* (cf. fig. 2, p. 190, t. c.): this may be taken as an expression of the greater equality of the several genital ocular plates, and as, *pro tanto*, an indication of a more archaic arrangement.

The anus is elongated from side to side, is of some size, and is placed just below the margin of the test: in *C. leskii* the anus is rounded; in *C. sigsbei* it would appear to be elongated transversely; but in the greater number of the members of the genus *Conoclypeus* it would appear, from the definition of Agassiz and Desor—"anus infra-marginal, allongé dans le sens du diamètre antéro-postérieur"—to be elongated along the axis at right angles to that in which it is elongated in our specimen.

The whole test is covered regularly by primary tubercles, all equal in and of some size; the only region in which there is the very slightest irregularity is in the intraambulacral region just in front of the mouth, where the tubercles are a little less closely packed; this arrangement is exceedingly interesting when compared with what obtains in *Echinolampas*. We have already had some examples of the archaic characters presented by *E. depressa*; and when we compare it on this point with *E. oviformis*, we find that in the former the tubercles are evenly distributed over the whole test, and that there are no bare bands, while in the latter a tract free from tubercles extends both forwards and backwards from the region of the actinostome.

Coming now to the final consideration, we have to inquire into the position of the apical system and of the actinostome. They have both left their central position, but have proceeded a very slight distance forwards; and the distance from the centre of the test is by no means so great as it is in the genera *Echinolampas* or *Rhynchopygus*, though it seems to be greater than in *Conoclypeus sigsbei*.

¹ Lovén, "Études sur les Échinoïdées," Kongl. Svens. Vetensk. Handlingar, Bd. ii. no. 7, p. 67.

² Dublin Quarterly Journal of Science, v. (1865), plate vii. fig. B.

The actinal surface of the test is completely plane; the abactinal surface is obtusely pyramidal, the area around the ocular and genital pores being flattened out to form what may be called an apical plateau.

I propose to call the genus to which this specimen belongs *Palæolampas*, and to define it thus:—

A petalostichous Echinid in which the completely parallel ambulacral pores remain paired as far as the ambitus, and in which the tendency to the shortening of one of the two sets is only very slightly indicated in the antero-lateral pair; the outer row of each pair of pores is regularly distributed from the apical area to the actinostome. Bourrelets feebly developed. Anus elongated transversely, infra-marginal. Four genital pores; ocular pores large. Tubercles all primary, and equally distributed over the test. Test not very high. Apical system and actinostome a little in front of the true centre of the test.

PALÆOLAMPAS CRASSA, nov. sp. (Plate IV.)

Test very thick, with a flattened apical plateau, pores of phyllodes not very regularly arranged; anus looks almost as much backwards as downwards; in the antero-lateral ambulacra the anterior row of pores shorter by three or four pairs than the posterior.

Hab. ? India.

The following are the more important measurements of the specimen described:—

	millim.
Greatest length	102
Greatest width	96
Greatest height	46
Length of anterior ambulacra	46
Length of antero-lateral ambulacra (right side)	46 : 49
" " " (left side)	44 : 50
Length of postero-lateral ambulacra (right side)	62
" " " (left side)	63
Distance from anterior edge of actinostome to edge of test	44
Distance from posterior edge of actinostome to posterior edge of test	50
Greatest antero-posterior axis of actinostome	8
Greatest transverse axis of actinostome	12
Greatest transverse axis of anus	12
Greatest antero-posterior axis of anus	~ 4
Greatest antero-posterior axis of madreporic plate	7
Greatest transverse axis of madreporic plate	7
Greatest intraambulacral width (from inner pores)	10
" " " (from outer pores)	14.5

It now remains only to discuss the systematic position of this interesting form. It obviously falls into the edentulous division of the Petalosticha, or into the Petalosticha as defined and limited by Alex. Agassiz. From the highly modified Spatangidæ it is at once distinguished by the absence of the plastron and of the semitæ;

